

**REMARKS**

Claims 166-169, 172-174, and 177-180 are pending in the Application

Claims 166-169, 172-174, and 177-180 are rejected.

Claims 166, 168-169, 172, 177 and 179 are amended herein.

Claim 189 is added herein.

**I. REJECTIONS UNDER 35 U.S.C. § 102(b) AS BEING ANTICIPATED BY KIANG**

The Examiner has rejected Claims 166, 167 and 172 under 35 U.S.C. § 102(b) as being anticipated by Kiang et al. “Carbon Nanotubes with Single-Layer Walls,” *Carbon*, 33, 7, 903-914 (1995) (“Kiang”). Fourth Office Action, at 2.

The Examiner makes reference to “page 905 of *Kiang*, the second column, lines 2-12 and to Figures 2a, 2b and 2c.” Fourth Office Action, at 2. The Examiner contends “[t]hese portions of *Kiang* disclose a membrane of substantially parallel single-wall carbon nanotubes.” *Id.* Examiner further contends that “[N]ot all of the nanotubes in the figures are substantially parallel, however, many of the nanotubes in this figure are substantially parallel...” *Id.*

Regarding Claim 166, Applicant has amended this claim by including the requirements that the array be “substantially two-dimensional” and that the array comprise “at least  $10^3$  single-wall carbon nanotubes.” Amended Claim 166 requires:

166. A membrane comprising an array of at least  $10^3$  single-wall carbon nanotubes in a substantially parallel relationship, wherein the membrane is nanoporous and wherein the array is a substantially two-dimensional array.

Anticipation requires each and every element of the claim to be found within the cited prior art reference.

In *Kiang* at 905, *Kiang* discloses the aggregation of single-wall carbon nanotubes into bundles. These bundles are essentially one-dimensional structures, as shown *Kiang* in the figures 2a, 2b and 2c, which show micrographs of individual single-wall carbon nanotubes and

these one-dimensional bundles. *Kiang* does not teach or disclose a membrane. Also, if it were assumed for the sake of argument that *Kiang* did teach or disclose a membrane, *Kiang* does not teach or disclose a membrane comprising an array of single-wall carbon nanotubes, wherein the array is a substantially two-dimensional array. Nor does *Kiang* teach or disclose a membrane comprising at least  $10^3$  single-wall carbon nanotubes in a substantially parallel relationship, wherein the membrane is nanoporous. Because *Kiang* does not disclose each and every element of Claim 166, as amended, this claim cannot be anticipated by *Kiang*.

Regarding Claim 167, this claim is dependent upon Claim 166 and thus includes all the elements of amended Claim 166. As stated above, *Kiang* does not teach or disclose all the elements of Claim 166. Furthermore, Claim 167 also requires that the membrane is conductive, and, even if it were assumed for the sake of argument that *Kiang* did teach or disclose a membrane, *Kiang* does not teach or disclose a membrane that is conductive. Thus, Claim 167 is not anticipated.

Regarding Claim 172, Applicant has amended this claim by claiming a membrane comprising carbon fibers that are aggregates of a plurality of single-wall carbon nanotubes, including the limitation that the plurality be at least  $10^6$  single-wall carbon nanotubes and that the membrane is substantially two-dimensional. Amended Claim 172 requires:

172. A membrane comprising carbon fibers that are aggregates of a plurality of at least  $10^6$  single-wall carbon nanotubes, wherein the plurality of single-wall carbon nanotubes are in a generally parallel orientation, and wherein the membrane is substantially two-dimensional.

As stated above, *Kiang* discloses one-dimensional bundles of single-wall carbon nanotubes. *Kiang* does not teach or disclose a membrane, nor does *Kiang* teach or disclose a substantially two-dimensional membrane. Furthermore, even if it were assumed for the sake of argument that *Kiang* did teach or disclose a membrane, *Kiang* does not teach or disclose a membrane comprising carbon fibers that are aggregates of a plurality of at least  $10^6$  single-wall carbon nanotubes, wherein the plurality of the single-wall carbon nanotubes are in a generally

parallel orientation. Because *Kiang* does not teach or disclose each and every element of Claim 172, as amended, this claim cannot be anticipated by *Kiang*.

Therefore, as a result of the foregoing, Applicant respectfully requests that the Examiner withdraw his rejection of Claims 166, 167 and 172 under 35 U.S.C. § 102(b) as being anticipated by *Kiang*.

## **II. REJECTIONS UNDER 35 U.S.C. § 103(a) AS BEING OBVIOUS OVER KIANG IN VIEW OF MURPHY AND IKEDA**

The Examiner has rejected Claims 168, 169, and 177-180 under 35 U.S.C. § 103(a) as being unpatentable over *Kiang* in view of both *Murphy et al.*, United States Patent No. 6,448,412 (“*Murphy*”) and *Ikeda et al.*, United States Patent No. 5,879,836 (“*Ikeda*”). Fourth Office Action, at 3. Applicant notes that it is unclear whether Examiner is rejecting these claims as obvious under 35 U.S.C. § 103(a) over (a) (i) *Kiang* in view of *Murphy* and also (ii) *Kiang* in view of *Ikeda* or (b) *Kiang* in view of *Murphy* and in view of *Ikeda*. Whichever the rejections may be, Applicant traverses such rejections.

### **A. Rejections over Kiang in view of Murphy and over Kiang in view of Ikeda**

Examiner contends that “*Kiang* sets forth all of the claimed subject matter except for the photoactive molecule attached to the membrane and for a lithium ion battery having a membrane. *Murphy* teaches...a fluorescent dye labeled to a fullerene.” Fourth Office Action, at 3. Examiner contends that “[t]o thus include in the single wall carbon nanotubes of *Kiang* the fluorescent dye as shown by *Murphy* would have been obvious to one of ordinary skill in this art at the time the invention was made so that the nanotubes can be traced within the body of a diseased person.” *Id.*

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the

claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based on applicant's disclosure. *See M.P.E.P. 706.02(j); see also In re Vaeck, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991).*

Regarding Claims 168 and 169, amended Claims 168 and 169 require:

168. A membrane comprising: (a) an array of at least  $10^3$  single-wall carbon nanotubes in a substantially parallel relationship, wherein the membrane is nanoporous and wherein the array is a substantially two-dimensional array; and (b) at least one photoactive molecule attached to the membrane.

169. A membrane comprising an array of at least  $10^3$  single-wall carbon nanotubes in a substantially parallel relationship, wherein (a) the membrane is nanoporous; (b) the array is a substantially two-dimensional array; and (c) at least one of the single-wall carbon nanotubes have ends that are derivatized with a photoactive dye molecule.

With regard to Claims 168 and 169, both of these claims require, *inter alia*, the claimed membrane comprise (i) an array of at least  $10^3$  single-wall carbon nanotubes in a substantially parallel relationship, (ii) a membrane that is nanoporous, and (iii) the array is a substantially two-dimensional array. As asserted above, *Kiang* does not teach, disclose, or suggest a membrane of single-wall carbon nanotubes, let alone a substantially two-dimensional array, or a membrane of at least  $10^3$  single-wall carbon nanotubes in a substantially parallel relationship, or a membrane that is nanoporous. Thus, the arguments presented above with respect to *Kiang*, are also applicable here.

*Murphy* teaches methods for multiply-derivatizing fullerenes having a C<sub>21-239</sub> fullerene core. *Murphy* does not teach, disclose, or suggest a membrane of single-wall carbon nanotubes, let alone a substantially two-dimensional array, or a membrane of at least  $10^3$  single-wall carbon nanotubes in a substantially parallel relationship, or a membrane that is nanoporous. Regarding Claims 168 and 169, *Kiang* and *Murphy* (either alone or in combination) do not teach or even suggest a membrane comprising, *inter alia*, any of those elements. Furthermore, there is no suggestion or motivation in either *Kiang* or *Murphy* to combine the teachings of *Kiang* with the

teachings of *Murphy*, and even, if the teachings of *Kiang* and *Murphy* were combined, the combination would not teach, disclose, or suggest all the claim limitations of amended Claims 168 and 169. Thus, Applicant asserts that each of amended Claims 168 and 169 is not *prima facie* obvious.

Regarding Claims 177-180, Examiner contends “[t]o have utilized the nanotubes in *Kiang* in the lithium battery shown by *Ikeda* would have been obvious so that a great output could have been realized because of the superior performance of the lithium battery.” *Id.*

Regarding Claim 177, amended Claim 177 requires:

177. A battery comprising a membrane, wherein the membrane comprises an array of at least  $10^3$  single-wall carbon nanotubes in a substantially parallel relationship, wherein the array is a substantially two-dimensional array.

*Kiang* does not teach, disclose, or suggest a battery. Nor does *Kiang* teach, disclose, or suggest a membrane. Even if it were assumed for the sake of argument that *Kiang* did teach, disclose, or suggest a membrane, *Kiang* does not teach, disclose, or suggest a membrane comprising an array of at least  $10^3$  single-wall carbon nanotubes in a substantially parallel relationship. Nor does *Kiang* teach, disclose, or suggest an array that is a substantially two-dimensional array.

Further regarding Claim 177, *Ikeda* does not teach, disclose, or suggest single-wall carbon nanotubes. Nor does *Ikeda* teach, disclose, or suggest a membrane. And like *Kiang*, even if it were assumed for the sake of argument that *Ikeda* did somehow teach, disclose, or suggest a membrane, *Ikeda* does not teach, disclose, or suggest a membrane comprising an array of at least  $10^3$  single-wall carbon nanotubes in a substantially parallel relationship. Nor does *Ikeda* teach, disclose, or suggest an array that is a substantially two-dimensional array. Furthermore, there is no suggestion or motivation in either *Kiang* or *Ikeda* to combine the

teachings of *Kiang* with the teachings of *Ikeda*, and even if the teachings of *Kiang* and *Ikeda* were combined, the combination would not teach or suggest all the limitations of Claim 177.

Thus, Applicant asserts that Claim 177, as amended, is not *prima facie* obvious, and Claim 178, which is dependent upon Claim 177, is also not *prima facie* obvious for the same reasons.

Regarding Claim 179, amended Claim 179 requires:

179. A battery comprising a membrane, wherein the membrane comprises carbon fibers that are aggregates of a plurality of at least  $10^6$  single-wall carbon nanotubes, wherein the plurality of single-wall carbon nanotubes are in a generally parallel orientation, and wherein the membrane is substantially two-dimensional.

Regarding Claim 179, *Kiang* does not teach, disclose, or suggest a battery. Nor does *Kiang* teach, disclose, or suggest a membrane, let alone a membrane that is substantially two-dimensional. Nor does *Kiang* teach, disclose, or suggest a membrane comprising carbon fibers that are aggregates of a plurality of at least  $10^6$  single-wall carbon nanotubes, wherein the plurality of the single-wall carbon nanotubes are in a generally parallel orientation.

Further regarding Claim 179, *Ikeda* does not teach, disclose, or suggest single-wall carbon nanotubes. Like *Kiang*, *Ikeda* also does not teach, disclose, or suggest a substantially two-dimensional membrane comprising carbon fibers that are aggregates of a plurality of at least  $10^6$  single-wall carbon nanotubes, wherein the plurality of the single-wall carbon nanotubes are in a generally parallel orientation.

Further regarding Claim 179, neither *Kiang* nor *Ikeda*, either alone or in combination, teaches, discloses, or even suggests a battery comprising a substantially two-dimensional membrane, wherein the membrane comprises carbon fibers that are aggregates of a plurality of at least  $10^6$  single-wall carbon nanotubes, wherein the plurality of the single-wall carbon nanotubes are in a generally parallel orientation. Furthermore, there is no suggestion or motivation in either *Kiang* or *Ikeda* to combine the teachings of *Kiang* with the teachings of

*Ikeda*, and even if the teachings of *Kiang* and *Ikeda* were combined, the combination would not teach or suggest all the limitations of Claim 179, as amended.

Thus, Applicant asserts that Claim 179, as amended, is not *prima facie* obvious, and Claim 180, which is dependent upon Claim 179, is also not *prima facie* obvious for the same reasons.

Therefore, as a result of the foregoing, Applicant respectfully requests that the Examiner withdraw his rejection of Claims 168, 169, and 177-180 under 35 U.S.C. § 103(a) as being unpatentable over *Kiang* in view of both *Murphy* and *Ikeda*.

**B. Rejections over Kiang in view of Murphy and in view of Ikeda**

For each of Claims 168 and 169, *Kiang*, *Murphy*, and *Ikeda* (alone or in combination) do not teach, disclose, or even suggest all of the limitations of these claims. As noted above, in Section II.A. for Claims 168 and 169, *Kiang* and *Murphy* (alone or in combination) fail to teach, disclose, or even suggest a number of limitations of each of Claims 168 and 169. *Ikeda* likewise does not teach, disclose, or suggest these same limitations.

Regarding Claims 177-180, *Kiang*, *Murphy*, and *Ikeda* (alone or in combination) likewise do not teach, disclose, or even suggest all of the limitations of these claims. As noted above, in Section II.A. for Claims 177-180, *Kiang* and *Ikeda* (alone or in combination) fail to teach, disclose, or even suggest a number of limitations of each of Claims 177-180. *Murphy* likewise does not teach, disclose, or suggest these same limitations.

Furthermore, there is no suggestion or motivation in any of *Kiang*, *Murphy*, or *Ikeda* to combine the teachings of *Kiang* with the teachings of *Murphy*, to combine the teachings of *Kiang* and *Ikeda*, to combine the teachings of *Murphy* and *Ikeda* or to combine the teachings of *Kiang*, *Murphy*, and *Ikeda*. And even if the teachings of *Kiang*, *Murphy*, and *Ikeda* were combined, the combination would not teach or suggest all the claim limitations. Thus, Applicant asserts that Claims 168, 169, and 177-180 are not *prima facie* obvious.

Therefore, as a result of the foregoing, Applicant respectfully requests that the Examiner

withdraw his rejection of Claims 168, 169, and 177-180 under 35 U.S.C. § 103(a) as being unpatentable over *Kiang* in view of both *Murphy* and *Ikeda*.

### **III. REJECTIONS UNDER 35 U.S.C. § 103(a) AS BEING OBVIOUS OVER KIANG IN VIEW OF STEPHAN**

The Examiner has rejected Claims 173-174 under 35 U.S.C. § 103(a) as being unpatentable over *Kiang* in view of Stephan *et al.*, “Doping Graphitic and Carbon Nanotube Structures with Boron and Nitrogen” *Science*, Vol. 266, Dec. 9, 1994, pp. 1683-1685 (“Stephan”). Fourth Office Action, at 3.

The Examiner contends “*Kiang* sets forth all of the claimed subject matter except for the dopant being a metal entrapped in the membrane. *Stephan* teaches in the abstract and on pages 1683-1684 boron being entrapped in the carbon nanotubes. To have incorporated the boron in the single walled carbon nanotube membrane of *Kiang* would have been obvious to modify these carbon materials for their known properties with boron.” Fourth Office Action, at 3-4.

Regarding Claim 173, Applicant asserts that there is a distinct difference between the teachings of *Stephan* and Claim 173. *Stephan* teaches incorporating boron *into* the carbon nanotube wall structure (*i.e.*, boron atoms are *chemically bonded* to carbon atoms), whereas, in contrast, Claim 173 requires “that at least one dopant” be “*physically entrapped between the single-wall carbon nanotubes of the carbon fibers*.” Thus, the teachings of *Stephan* including bonded boron atoms actually *teaches away* from the claimed invention of Claim 173. Moreover, neither *Kiang* nor *Stephan* discloses a membrane.

Thus, neither *Kiang* nor *Stephan* (either alone or in combination) teaches, discloses or even suggests the claimed invention of Claim 173. Furthermore, there is no suggestion or motivation in either *Kiang* or *Stephan* to combine the teachings of *Kiang* with the teachings of *Stephan*, and even if the teachings of *Kiang* and *Stephan* were combined, the combination would not teach or suggest all the limitations of Claim 173.

Thus, Applicant asserts that Claim 173 is not *prima facie* obvious, and Claim 174, which is dependent upon Claim 173, is also not *prima facie* obvious for the same reasons.

Applicant further notes that it has also added new claim 189, which depends from Claim 173 and includes the requirements that the plurality of single-wall carbon nanotubes is at least  $10^6$  single-wall carbon nanotubes and that the membrane is a substantially two-dimensional membrane. Regarding new Claim 189, *Kiang* does not teach, disclose, or suggest a membrane, let alone a substantially two-dimensional membrane. Nor does *Kiang* teach or suggest a membrane comprising carbon fibers that are aggregates of a plurality of at least  $10^6$  single-wall carbon nanotubes, wherein the plurality of the single-wall carbon nanotubes are in a generally parallel orientation. Thus, this new claim is not obvious for these reasons, as well as for the reasons Claim 173 (from which 189 depends) is not obvious.

Therefore, as a result of the foregoing, Applicant respectfully requests that the Examiner withdraw his rejection of Claims 173-174 under 35 U.S.C. § 103(a) as being unpatentable over *Kiang* in view of *Stephan*.

**IV. CONCLUSION**

As a result of the foregoing, it is asserted by Applicant that the Claims in the Application are now in a condition for allowance, and respectfully requests allowance of such Claims.

Applicant respectfully requests that the Examiner call Applicant's attorney at the below listed number if the Examiner believes that such a discussion would be helpful in resolving any remaining problems.

Respectfully submitted,

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